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Cost Effectiveness of Statin Therapy in the Lowering of Cholesterol in Patients at Dwight D. Eisenhower Army Medical Center

A Graduate Management Project

by

MAJ Daniel H. Jimenez

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ABSTRACT

Selecting efficient treatment strategies requires the careful consideration of both the effectiveness and cost of therapy. With over $1,150,000 expended on statin drugs at Eisenhower Army Medical Center, the utilization of a cost-effectiveness analysis tool, cost-effectiveness ratio (CER), was employed to evaluate the success of cholesterol lowering on those patients undergoing treatment. This retrospective quantitative study determined that the most cost effective statin in LDL-C reduction used during FY 99 was pravastatin (CER=14.2). By applying the same cost-effectiveness measurement tool, cerivastatin (CER=4.7) proved significantly more cost effective than pravastatin at LDL-C reduction. The final objective of this study measured the effect of statin drug conversions on a patient's LDL-C level due to formulary limitations. Comparison of statin drug conversion on LDL-C levels revealed that drug conversion did not cause a significant increase in the LDL-C levels of patients (p=.113 for atorvastatin to simvastatin conversion, p=.072 for pravastatin to simvastatin conversion, and p=.331 for pravastatin to cerivastatin conversion). In addition, the study determined that these conversions did not cause a significant change in the ability for a patient to reach their LDL-C goal (p=.571 for atorvastatin to simvastatin conversion, p=.579 for pravastatin to simvastatin conversion, and p=.068 for pravastatin to cerivastatin conversion). For the health care administrator, this project supports the ideal that sound business practices, which simultaneously consider clinical outcomes, can successfully maximize the utilization of scarce health care resources.

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INTRODUCTION

Conditions Which Prompted the Study

Coronary heart disease (CHD) is and most likely will remain the leading cause of death and disability in the United States, because it accounts for a higher mortality rate than the next seven leading causes of death combined (American Heart Association, 1997). Due to this lofty position, it is also the leading source of health care expenditures (Centers for Disease Control and Prevention, 1994). Despite mass media campaigns and aggressive screening programs to identify and address risk factors such as high cholesterol, hypertension, and smoking, CHD remains the leading killer in industrialized Western countries. By one estimate, direct medical costs for CHD in the United States exceeds $100 billion dollars a year, with the majority of those expenditures consumed for bypass grafting and hospitalization (AHA, 1997). As the practice of medicine, in both civilian and military health care systems, undergoes a paradigm shift due to a managed care approach, a greater emphasis on cost effective approaches to cardiovascular disease management is necessary for continued profitability.

There is indisputable evidence that serum cholesterol concentration has a direct causal relationship with CHD,

although the exact mechanism of action is unknown (Law, Wald, & Thompson, 1994). The availability of such evidence suggests that reducing serum cholesterol concentration will reduce the prevalence of CHD and by direct association reduce overall health care costs. The β-hydroxy-β-methylglutaryl-coenzyme A (HMG Co A) reductase inhibitors, also known as statins, represent a major breakthrough in the prevention of CHD by lowering serum cholesterol levels. The literature is rich with studies that applaud the benefits of statins in primary (Shepherd, Cobbe, Ford, Isles, Lorimer, & MacFarlane, 1994; Steinhagen-Thiessen, 1994) and secondary (Goldman, Weinstein, Goldman, & Williams, 1991; Rossouw, Lewis, & Rifkind, 1990) prevention of CHD in clinical trials. Despite the vast body of evidence that supports early and aggressive intervention in individuals at risk for CHD, the treatment benefits demonstrated in the clinical trials are unfortunately not fully replicated in the general population (Nieto, Alonso, Chambless, Zhong, Ceraso, Romm, Cooper, Folsom, & Szklo, 1995).

At Dwight D. Eisenhower Army Medical Center (DDEAMC) statins are used in both the primary and secondary prevention of CHD. Statin expenditures have continued to increase since their addition to the formulary over five years ago. For example, in Fiscal Year (FY) 98 statin expenditures were $840,000 while in

FY 99 the dollar amount topped $1,165,000. This equates to a 39% increase in statin expenditures in just a one-year period. The statin class of drugs alone accounted for over eight percent of total pharmacy expenditures in FY 99. These expenditures easily make statins one of the top three most costly drug classes dispensed at DDEAMC. Two statins were available on the formulary (pravastatin and simvastatin) and two were available under special order criteria (atorvastatin and fluvastatin) during the period of FY 97 to FY 99.

Due to double-digit inflation in the pharmaceutical market and an effort to control the Department of Defense (DoD) expenditures on statins, the DoD Pharmacoeconomic Center (PEC) implemented a statin contract that officially limited the statin drug class on the basic core formulary (BCF). Effective October 1, 1999 all military treatment facilities (MTF) formularies must only have the statins cerivastatin and simvastatin. Cerivastatin and simvastatin were selected because of their established therapeutic effects and as a mechanism to improve uniformity of the pharmacy benefit for DoD beneficiaries as well as enhance the economic efficiency of the military health system (MHS). Non-contracted statins (atorvastatin, pravastatin, fluvastatin, and lovastatin) will only be available through special order drug requests and not appear on the BCF

(Richerson, DeGroff, & Remund, 1999). Special instructions issued by the PEC tasked pharmacy department heads and service chiefs to expedite the conversion of patients to approved statins by April 1, 2000 without causing undue inconvenience to either beneficiaries or providers.

Statement of the Problem

Selecting efficient treatment strategies necessitates the careful consideration of both the effectiveness and cost of therapy. The significant dollar amounts expended on statin drugs at DDEAMC requires evaluation of the effectiveness of cholesterol lowering on those patients undergoing treatment. Cost-effectiveness analysis, which compares the differential cost and outcomes of health care interventions, can be used to compare the overall effect of individual treatments involved in lowering a patient’s cholesterol.

In addition, the decision by the DoD PEC to limit the statin drug class on the BCF to cerivastatin and simvastatin will directly impact patients at DDEAMC. All patients currently receiving atorvastatin, fluvastatin, and pravastatin must be converted to either cerivastatin or simvastatin by April 1, 2000.

The questions this research project will attempt to answer are:

1. What was the most cost-effective statin at DDEAMC during FY 99?

2. Is cerivastatin as cost-effective as the statins used in FY 99?

3. What are the effects on patient LDL-C levels and their ability to reach LDL-C goal at DDEAMC due to limiting statins on the BCF based on the statin contract negotiated by the DoD PEC?

Literature Review

The first statin, lovastatin, was introduced to the market over ten years ago, the same year that the National Cholesterol Education Program (NCEP) released its first detection and treatment guidelines. Since then, five other statins have hit the marketplace (pravastatin, simvastatin, fluvastatin, atorvastatin, and cerivastatin). With the advent of statins, the understanding of the pathogenesis of CHD and approaches to alter the natural history of the disease have accelerated.

Pharmacology

Statins appear to produce their effects by competitively inhibiting the enzyme HMG Co A reductase, which is responsible for one of the rate-limiting steps in the biosynthesis of cholesterol (Physicians' Desk Reference, 1999). By interfering with this metabolic process in the hepatic (liver) cell, statins cause a deficiency of endogenous cholesterol that stimulates

intracellular mechanisms aimed at increasing the cholesterol concentration. One of these mechanisms is the up-regulation of low-density lipoprotein (LDL) receptors (also called B-E receptors). These protein receptors are expressed on the surface of the hepatic cell and provide a binding ligand for apolipoproteins B and E on the surface of very low-density lipoprotein (VLDL) and LDL particles circulating in the blood (PDR, 1999). Once bound by the receptor ligand, these particles are taken up into the hepatic cell thereby providing cholesterol to restore that which was lost from reduced synthesis. To put it simply, there is less bad cholesterol circulating in the blood.

A review of each of the statins, in the PDR and the package inserts provided by each manufacturer, unveiled the mechanism that accounts for the dominant effect of this class of drugs; the lowering of LDL-cholesterol (LDL-C). Table 1 outlines the results of this evaluation. Analysis of this table indicates that LDL-C reduction averages 20 to 30% with pravastatin to an average of 35 to 58% with atorvastatin. The reason for simvastatin being twice as potent as fluvastatin, cerivastatin, and lovastatin and atorvastatin being four times as potent in lowering LDL-C is unexplained (PDR, 1999).

Table 1

Dose Related LDL-C Lowering of Major Lipid Drugs

Drug	Daily Dosage (mg)	% LDL-C Lowering
Lovastatin	10	-22
	20	-27
	40	-32
	80	-39
Pravastatin	10	-20
	20	-27
	40	-30
Simvastatin	5	-23
	10	-30
	20	-35
	40	-40
	80	-46
Fluvastatin	20	-22
	40	-26
	80	-34
Cerivastatin	.2	-27
	.3	-29
	.4	-34
Atorvastatin	10	-35
	20	-43
	40	-51
	80	-58

As outlined in Table 2, statins generally lower triglycerides (TG) 10 to 20% with the exception of atorvastatin, which lowers TG 25 to 46% (PDR, 1999). In addition, high-density lipoprotein cholesterol (HDL-C) is generally elevated 6 to 12% with the exception of fluvastatin, which only raises HDL-C 3 to 5%.

Table 2

Average Effects of Statins on Blood Lipids

Drug	LDL-C (%)	HDL-C (%)	TG (%)
Lovastatin (10-80 mg/dose)	-22 to 39	+6 to 10	-10 to 19
Pravastatin (10-40 mg/dose)	-20 to 30	+7 to 12	-11 to 24
Simvastatin (5-80 mg/dose)	-23 to 46	+7 to 12	-10 to 19
Fluvastatin (20-80 mg/dose)	-22 to 34	+3 to 5	-3 to 14
Cerivastatin (.2-.4 mg/dose)	-27 to 34	+10 to 12	-10 to 13
Atorvastatin (10-80 mg/dose)	-35 to 58	+3 to 12	-25 to 46

Selecting the cholesterol-lowering regimen for a patient is generally based on the detection and treatment guidelines provided by the NCEP (Jackson, 1993) as outlined in Table 3 below. Risk factors include age (> 45 years for men and > 55 years for women), CHD and menopause history, hypertension, cigarette smoking, ethyl alcohol consumption, HDL-C < 35 mg/dL, and diabetes mellitus (Huse, Russell, Miller, Kraemer, D'Agostino, Ellison, & Hartz, 1998).

Table 3

Treatment Decisions Based on LDL-C

Patient Categorization	Diet Initiation	Drug Initiation	LDL-C Goal
No CHD with < 2 risk factors (Primary Prevention)	≥ 160 mg/dL	≥ 190 mg/dL	< 160 mg/dL
No CHD with ≥ 2 risk factors (Primary Prevention)	≥ 130 mg/dL	≥ 160 mg/dL	< 130 mg/dL
With CHD(Secondary Prevention)	> 100 mg/dL	≥ 130 mg/dL	≤ 100 mg/dL

The intended effects and selection of statin therapy is most often based on the probability that the selected statin dosage will lower LDL-C to < 100 mg/dL (Grundy, 1998). Table 4 is an example of a decision matrix used to select the appropriate statin to assist a patient in reaching their LDL-C goal. For example, if a patient has an LDL-C of 160 mg/dL prescribing 40 mg of fluvastatin only has a 30% chance of lowering his LDL-C to 100 mg/dL. However, a 10 mg daily dose of atorvastatin has a 56% probability of lowering the LDL-C level to 100 mg/dL.

Table 4

The Probability that a Statin Will Lower LDL-C to < 100 mg/dL

Baseline LDL-C (mg/dL)	Lovastatin 40 mg	Simvastatin 20 mg	Fluvastatin 40 mg	Pravastatin 40 mg	Atorvastatin 10 mg
130	71%	69%	54%	71%	79%
140	63%	61%	44%	63%	72%
150	54%	52%	35%	54%	64%
160	45%	43%	30%	45%	56%
170	29%	37%	28%	37%	40%
180	23%	27%	14%	29%	35%
190	20%	21%	10%	23%	32%
200	17%	16%	6%	17%	26%

Effect of Statins on Patient Outcome

In the past five years, studies have demonstrated that not only are statins the most potent LDL-C lowering agents, but they

also provide important reductions in the risk of CHD events (Scandinavian Simvastatin Survival Study Group (4S), 1994; Post Coronary Artery Bypass Graft Trial Investigators (PCABGTI), 1997). The West of Scotland Coronary Prevention Study (WESCOPS) evaluated the effect of a fixed dose of pravastatin (40 mg daily) against a placebo in 6595 men, most of whom had no clinical evidence of CHD (Shepard et al, 1994). The average man in this trial was 55 years of age, and had two risk factors for CHD with a mean LDL-C of 192 mg/dL. Pravastatin reduced LDL-C by 26% during the course of this trial after accounting for the effect of a placebo on LDL-C. The combination of CHD deaths and nonfatal heart attacks, the primary outcome variable, was significantly reduced from 7.9% in placebo-treated patients to 5.5% in pravastatin-treated patients, a 24% relative risk reduction ($p=0.003$) and a 2.4% absolute risk reduction (Shepard et al, 1994). The number of patients needed to treat to prevent one of these combined outcomes was 42. Differences in the effect of pravastatin versus a placebo on the primary outcome variable were seen as early as six months into the trial.

The Scandinavian Simvastatin Survival Study considered 4444 men and women who had evidence of CHD and total cholesterol levels between 213 and 310 mg/dL with a mean baseline LDL-C 189 mg/dL (4S, 1994). Simvastatin therapy was initiated at 20

mg/day. A few patients were titrated down to 10 mg/day, while about one-third had to be titrated up to 40 mg daily. This resulted in a mean dose of 27 mg/d for all patients in the study. This dose reduced LDL-C an average of 35%. All cause mortality, the primary outcome of the study, occurred in 11.5% of placebo-treated patients compared to 8.2% of simvastatin-treated patients for a relative risk reduction of 30% (p=.0003) and an absolute risk reduction of 3.3% (4S, 1994). The number of patients needed to treat to prevent one death was 30.

The Coronary and Recurrent Events (CARE) trial enrolled men and women who had previously experienced a myocardial infarction (Sacks, Pfeffer, Moye, Rouleau, Rutherford, Cole, Brown, Warnica, Arnold, Wun, Davis, & Braunwald, 1996). These 4159 patients had LDL-C levels between 115 and 174 mg/dL and a mean LDL-C of 135 mg/dL. These patients received a fixed dose of pravastatin (40 mg daily) or a placebo for 5 years. The primary endpoint of the study, fatal CHD or nonfatal myocardial infarction, was recorded in 13.2% of placebo-treated patients and 10.2% of pravastatin-treated patients for a relative risk reduction of 24% (p=.003) or an absolute risk reduction of 3%. The number of treated patients needed to prevent one event was 33 (Sacks et al, 1996).

In all of these trials, aggressive lipid lowering therapy also impacted other outcomes of importance that directly affect health care costs. For example, costly invasive procedures (i.e. angioplasty and by-pass surgery) decreased as well as the incidence of stroke. In the 4S and WESCOPS studies, there was also a substantial reduction in overall mortality. Significant reductions in CHD events occurred in both men and women, in the elderly, in diabetics as well as the other risk factor categories previously mentioned.

Taken together, these trials demonstrate that substantial and achievable LDL-C reduction with pravastatin and simvastatin resulted in significant decreases in survival indicators. When compared to non-statin clinical trial results (Knopp, Ginsberg & Albers, Hoff, Ogilvie, Warnick, Burrows, Retzlaff, & Poole, 1985), the statin trials demonstrate that the greater LDL-C reductions achieved with statins correlate with a greater impact on CHD risk reduction. These data and available literature generally suggest that greater reductions in LDL-C, provides greater benefit to the patient.

Substantiating this observation is the recently published Post-Coronary Artery Bypass Graft study of patients who had undergone coronary by-pass surgery because of atherosclerotic vascular disease (PCABGTI, 1997). The patients in this study

had prior LDL-C levels between 130 and 175 mg/dL. All patients received random assignment to a moderate or aggressive treatment group. The moderate treatment group achieved a LDL-C from 132 to 136 mg/dL and the aggressive treatment group achieved a LDL-C from 93 to 97 mg/dL after treatment with lovastatin. The aggressively treated group had better outcomes and required fewer invasive surgical procedures than did the moderately treated group.

A thorough review of these four studies indicates that they all employed a rigorous clinical trial design. This included randomization of qualified patients to an active statin-treatment group or a placebo control group, double-blinding of the investigator and patients, and long-term evaluation of treatment effects (4.5 to 5.5 years). Each of the studies was populated with sufficient numbers of patients to test the impact of the test statin on a pre-defined patient outcome.

The scientific literature is abundant with information that hails the cost effectiveness of lipid modifying therapy with statins (Schwartz, 1999; Kessler, 1999; Jackson, 1999). This class of drugs is instrumental in the extension of life and the preservation of its quality for patients actively striving to reach their NCEP LDL-C goals. In the 4S, CARE and WESCOPS studies discussed above, statins produced significant reductions

in total mortality (extension of life) and heart attacks (preservation of quality) (Goldman et al, 1991). The clinical effectiveness demonstrated by the statins in these studies was clearly superior to that previously established with less potent bile acid resins, niacin, and gemfibrozil (Goldman et al, 1991). This superior effectiveness correlates with the greater LDL-C reduction produced with statins than with other cholesterol lowering agents.

The cost-effectiveness of the statins is substantially affected by their clinical effectiveness. The savings they garner from avoiding costly medical interventions can discount the cost of therapy. For example, the savings obtained from shorter hospital stays and revascularization procedures in the 4S study reduced the net cost of simvastatin therapy to 28 cents per day (Pedersen, Kjekshus, Berg, Olsson, Wilhelmsen, Wedel, Pyorala, Miettinen, Haghfelt, Faergeman, Thorgeirsson, Jonsson, & Schwartz, 1996). Presumably, these savings would at least be sustained, if not considerably increased, as therapy is continued, giving rise to the possibility that long-term treatment with statins may turn out to be cost neutral.

Based on current evidence, it is clinically effective to treat patients with CHD (secondary prevention) and patients without CHD but with two or more risk factors (primary

prevention) with statins and diet (Force, 1997). It is also cost-effective. Using the fact that it costs about $50,000 per year of life saved (YOLS) to treat mild hypertension, spending up to $15,000 per YOLS for secondary prevention of CHC and up to $40,000 per YOLS for primary prevention of CHD with statin therapy in patients with multiple risk factors appears reasonable and less expensive (Goldman et al, 1991).

In many respects, the greatest challenge facing the health care professional when treating hyperlipidemia is to keep the patient on long term therapy. Statistics reveal consistently that about 50% of treated patients will discontinue their therapy within one year of starting it (Grundy, 1998). The compelling news is that the discontinuation rates with statins at 15%, as measured in one health maintenance organization, are far better than discontinuation rates with either bile acid resins at 41% or niacin at 45% (Andrade, Walker, Gottlieb, Hollenberg, Testa, Saperia, & Platt, 1995).

Purpose of the Study

As DDEAMC operates with a managed care approach, the principles of better clinical and business practices must be explored to maximize the utilization of scarce health care resources. This research project has three main terminal

objectives. The first objective of this project is to perform a retrospective quantitative study to determine the most cost effective of the three statin drugs (pravastatin, atorvastatin, and simvastatin) used at DDEAMC during FY 99. The second objective is to determine if the new statin, cerivastatin, is as cost-effective as the statins used during FY 99. The final objective of this project is to examine statin conversion patients to determine if a statistical difference exists in their treatment results due to the DoD PEC directive that limits the BCF on statin drugs.

METHODS AND PROCEDURES

The intent of this applied management research project (Cooper & Schindler, 1998) was to conduct a four phased process; first develop the cost-effectiveness model, second collect the data, next analyze the results, and finally effectively communicate the derived information. This project employed a cost-effectiveness model similar to that used by Shulman and his colleagues and the Lipid Treatment Assessment Project (LTAP). Cost-effectiveness for the purpose of this study is defined as the present value of the cost of therapy divided by the percent change in LDL-C values (Shulman et al, 1990; Goldman et al, 1991). The result of this calculation is a cost-effectiveness

ratio (CER). A low average CER indicates that fewer resources are consumed to produce a given effect. Therefore, with all else being equal, lower ratios are preferred to higher ones. This cost-effectiveness technique was selected because it will provide results in a format readily understandable by both clinicians and administrators at this facility.

The selection criteria for patients in this study included:

1. TC levels in excess of 250 mg/dL and LDL-C levels in excess of 160 mg/dL.
2. Possess at least two risk factors for CHD according to NCEP guidelines.
3. A period of at least six months between hyperlipidemic diagnosis and initiation of statin therapy occurred in order to satisfy the diet treatment period outlined by the NCEP.
4. Patients can not be taking more than one statin drug at a time.
5. Patients must be on the statin drug for a minimum of twelve weeks.

For each of the three statin drugs in use at DDEAMC during FY 99, a matrix was developed to calculate cost effectiveness. Each statin's matrix included an unique identification code, age, gender, TC and LDL-C value at start of therapy, TC and LDL-C value while on statin therapy (for at least twelve weeks), and

if their LDL-C goal is reached. An example of these matrixes is located at Appendix C. Statistical analysis of this data included calculation of CERs, descriptive and inferential statistics for each of the statin drugs. The same criteria will be used to evaluate the cost-effectiveness of cerivastatin in order to compare cost-effectiveness. The Composite Health Care System (CHCS) was used to obtain necessary utilization, drug, and laboratory data.

The final purpose of this project is to examine statin conversion patients to determine if a statistical difference exists in their treatment results due to the DoD PEC directive limiting the BCF on statin drugs. For each of the three conversions; atorvastatin to simvastatin, pravastatin to simvastatin, and pravastatin to cerivastatin, a matrix was developed to evaluate LDL-C results. Each conversion matrix included an unique identification code, age, gender, TC and LDL-C value on initial statin, TC and LDL-C value on conversion statin (for at least twelve weeks), and various LDL-C goal status measures. The example of these matrixes is located at Appendix D. Statistical analysis of this data included descriptive and inferential statistics for each of the three conversion scenarios. CHCS was used to obtain necessary utilization, drug, and laboratory data.

Ethical principles were considered in the preparation and execution of this study. While unique identification codes are used in the evaluation of collected data, patient names or patient identifiers will not be reported at the conclusion of this study. Therefore, this research does not have to address patient privacy and confidentiality issues with the DDEAMC Institutional Review Board.

RESULTS

The purpose and supporting objectives of this project have been accomplished. This retrospective quantitative study accomplished its first objective by determining that the most cost effective statin in LDL-C reduction used at DDEAMC during FY 99 was pravastatin with a CER of 14.2. The second objective was accomplished by determining that cerivastatin, the newest statin, with a CER of 4.7 is significantly more cost effective than any statin at LDL-C reduction used at DDEAMC during FY 99. In addition, by factoring in the new pricing for simvastatin, available through the PEC statin contract, simvastatin’s CER of 13.6 is better than that of pravastatin (14.2). The complete results of this analysis are shown in Table 5 below.

Table 5

Cost-effectiveness Analysis of LDL-C Reduction

Alternative	Cost of Medication ($)	Effectiveness (% LDL-C Change)	Cost-Effectiveness Ratio
Atorvastatin	643.29	24.49	26.3
Cerivastatin	110.00	23.6	4.7
Pravastatin	323.76	22.75	14.2
Simvastatin	622.96	28.57	21.8
Simvastatin *	388.00	28.57	13.6

* Result if new PEC contract pricing is used.

Table 6 shows the results of a comparison of the descriptive statistics of the statin drugs on the reduction of TC and LDL-C. Of particular interest is the percent of patients reaching their LDL-C goal with statin therapy. Simvastatin patients achieved the best results with 48% reaching LDL-C goal followed by pravastatin patients (46.3%), then cerivastatin patients (33.3%) and lastly atorvastatin patients (26.5%).

A comparison of the inferential statistics, paired samples, of the base TC and the TC while on statin therapy is illustrated in Table 7. The software package Statistical Package for the Social Sciences (SPSS) for Windows version 10.0 was used to generate these results. A review of these results reveals that

all of the statin drugs studied caused a significant decrease in the TC of patients undergoing statin therapy (p<.0001).

Table 6

Descriptive Statistics of Statin Drugs on TC and LDL-C Reduction

	Atorvastatin	Cerivastatin	Pravastatin	Simvastatin
Subjects (n=)	34	42	121	50
Mean Age	61.9 (8 SD)	61 (10.2 SD)	59.6 (11.1 SD)	60.4 (11.4 SD)
Mean Risk Factors	2.4 (.5 SD)	2.4 (.5 SD)	2.5 (.6 SD)	2.6 (.7 SD)
Percent Male	35.3	47.6	40.5	42
Mean Dosage	27.1 (14.3 SD)	.38 (.06 SD)	24.5 (9.7 SD)	69 (20.4 SD)
Mean Starting TC	291.7 (30.4 SD)	282 (28.1 SD)	281.4 (27.4 SD)	300.6 (66.7 SD)
Mean TC on Drug	243.2 (33.6 SD)	238.8 (36.9 SD)	231.2 (42.3 SD)	235.1 (47.1 SD)
Mean Decrease in TC	50.3 (26.1 SD)	43.2 (33.9 SD)	50.2 (41.1 SD)	65.4 (63.9 SD)
Mean Starting LDL-C	186.3 (26.9 SD)	185.1 (22.8 SD)	186.1 (22.5 SD)	196.4 (41.8 SD)
Mean LDL-C on Drug	142.4 (32.4 SD)	141.2 (33.6 SD)	142.7 (33.9 SD)	137.2 (32.3 SD)
Mean Decrease in LDL-C	44.9 (19.3 SD)	43.9 (33.9 SD)	43.4 (36.4 SD)	59.2 (48.5 SD)
% Reaching LDL-C Goal	26.5	33.3	46.3	48

A comparison of the inferential statistics of the base LDL-C and the LDL-C while on statin therapy is illustrated in Table 8. A review of these results reveals that all of the statin drugs studied caused a significant decrease in the LDL-C of patients (p<.0001).

Table 7

Inferential Statistics (Paired Samples) of Base TC and Drug TC

	Atorvastatin	Cerivastatin	Pravastatin	Simvastatin
Subjects (n=)	34	42	121	50
Mean Reduction	48.5	43.21	50.25	65.42
Standard Deviation	25.27	33.93	41.15	63.95
Standard Error Mean	4.33	5.24	3.74	9.04
t	11.19	8.25	13.43	7.23
df	33	41	120	49
p	<.0001	<.0001	<.0001	<.0001

Table 8

Inferential Statistics of Base LDL-C and Drug LDL-C

	Atorvastatin	Cerivastatin	Pravastatin	Simvastatin
Subjects (n=)	34	42	121	50
Mean Reduction	43.91	43.86	43.4	59.2
Standard Deviation	19.19	30.34	36.35	48.51
Standard Error Mean	3.29	4.68	3.3	6.86
t	13.35	9.37	13.13	8.63
df	33	41	120	49
p	<.0001	<.0001	<.0001	<.0001

One of the marketing strategies used by the various manufactures of statin drugs focuses on ranges of percent reduction in LDL-C values. This marketing strategy generally emphasizes that the vast number of patients achieve results in the 30-40% and the greater than 40% LDL-C reduction range. The results from the analysis of DDEAMC statin patients are outlined in Table 9 below. In general, more than 60% of DDEAMC patients had less than a 30% reduction in their LDL-C levels.

Table 9

% LDL-C Reduction Ranges by % of Patients in those Ranges

	Atorvastatin	Cerivastatin	Pravastatin	Simvastatin
Subjects (n=)	34	42	121	50
% LDL-C Reduced < 20%	38.24	38.1	41.32	34
% LDL-C Reduced > 20-30%	29.41	38.1	19.83	18
% LDL-C Reduced > 30-40%	20.59	9.52	23.97	24
% LDL-C Reduced > 40%	11.76	14.28	14.88	24

The final objective of this study centered on the effect of statin drug conversions on a patient's LDL-C level due to the DoD PEC decision limiting the drug class on the BCF to cerivastatin and simvastatin. The result of this comparison is presented in Table 10. In general, conversion from pravastatin to cerivastatin and conversion from pravastatin to simvastatin

resulted in more patients reaching LDL-C goal 8.62% and 2.22%, respectively, while the conversion from atorvastatin to simvastatin resulted in 2.78% fewer patients reaching LDL-C goal.

Table 10

Conversion Comparison of Statin Drugs on Reaching LDL-C Goals

	Atorvastatin to Simvastatin	Pravastatin to Simvastatin	Pravastatin to Cerivastatin
Subjects (n=)	36	135	116
Meeting Goal to Meeting Goal	25	94	66
% Meeting Goal to Meeting Goal	69.44	69.63	56.9
Meeting Goal to Not Meeting Goal	2	13	10
% Meeting Goal to Not Meeting Goal (A)	5.56	9.63	8.62
Not Meeting Goal to Meeting Goal	1	16	20
% Not Meeting Goal to Meeting Goal (B)	2.78	11.85	17.24
Not Meeting Goal to Not Meeting Goal	8	12	20
% Not Meeting Goal to Not Meeting Goal	22.22	8.89	17.24
% Overall Change (B – A)	-2.78	2.22	8.62

A comparison of the inferential statistics of the statin drug conversion on LDL-C results is illustrated in Table 11. A review of these results reveals that these conversions did not cause a significant increase in the LDL-C levels of patients

(*p*=.113 for atorvastatin to simvastatin conversion, *p*=.072 for pravastatin to simvastatin conversion, and *p*=.331 for pravastatin to cerivastatin conversion).

Table 11

Inferential Statistics on Conversion of Statins on LDL-C Results

	Atorvastatin to Simvastatin	Pravastatin to Simvastatin	Pravastatin to Cerivastatin
Subjects (n=)	36	135	116
Mean Reduction	-5	4.64	2.21
Standard Deviation	18.48	29.72	24.34
Standard Error Mean	3.08	2.56	2.26
t	-1.62	1.82	.98
df	35	134	115
p	.113	.072	.331

A comparison of inferential statistics of the statin drug conversion on patients reaching LDL-C goal is presented in Table 12. Review of these results reveals that these conversions did not cause a significant change in the ability of patients to reach LDL-C goal (*p*=.571 for atorvastatin to simvastatin conversion, *p*=.579 for pravastatin to simvastatin conversion, and *p*=.068 for pravastatin to cerivastatin conversion).

Table 12

Inferential Statistics on Conversion of Statins on LDL-C Goals

	Atorvastatin to Simvastatin	Pravastatin to Simvastatin	Pravastatin to Cerivastatin
Subjects (n=)	36	135	116
Mean Reduction	.028	-.022	-.089
Standard Deviation	.29	.46	.5
Standard Error Mean	.049	.04	.047
t	.57	-.56	-1.85
df	35	134	115
p	.571	.579	.068

DISCUSSION

The literature is loaded with documentation that applauds the use of statins as a cost effective approach in the primary prevention of CHD (Force, 1998; Goldman et al, 1991; Huse et al, 1998; Pearson, 1998; Schulman et al, 1990; Shepard et al, 1994). It is interesting to note that while these studies focused on the cost-effectiveness of statins on the primary prevention of CHD, they did not explore the same objectives investigated in this project. While the investigation of NCEP goal attainment in LDL-C reduction is consistently reported in these studies,

the effect of changing statin therapy is not. This project was successful in exploring both of these objectives within the DDEAMC patient population. In addition, the cost-effectiveness technique utilized in data evaluation is understandable by both clinicians and administrators and is applicable to other treatment regimens such as anti-hypertensive therapy.

After a thorough evaluation of over 2500 patient records and laboratory test result files, it is clear that the directive of the DoD PEC limiting the BCF on statin drugs is cost effective while not adversely impacting patient care. The results of this project support the ideal that sound business practices that simultaneously consider clinical outcomes can successfully maximize the utilization of scarce health care resources. The following discussion of the results and observations obtained during this project will expose the benefits of employing statin therapy cost-effectiveness analysis to both health care providers and health care administrators.

As one might expect, the cost-effectiveness of statin treatment is extremely sensitive to the price of the drug used. Since effectiveness, as measured by percent LDL-C change in this project, for all of the statin drugs are similar (mean=24.85, SD=2.58) drug cost is a predictor of a drug's CER. Since cerivastatin's cost is only a third of the next lowest cost

statin (pravastatin), it is understandable that it is by far the most cost effective treatment. This is further illustrated by comparing the CER of simvastatin under the FY 99 pricing and applying the DoD PEC contract price. A 37.72% decrease in the cost of simvastatin ($622.96 to $388) results in a proportional reduction in its CER (21.8 to 13.6). In calculating the CERs of statin treatment the assumption of 100% compliance is made, even though in the literature suggests that compliance falls to about 70% in five years (Pickin, McCabe, Ramsay, Payne, Haq, Yeo, & Jackson, 1999). Since it is unknown if any DDEAMC patients became non-compliant during the first year of their therapy, estimated costs assume 100% compliance, a conservative assumption that is in-line with published recommendations (Buxton, Drummond, Van Hout, Prince, Sheldon, Szucs, & Vray, 1997).

The main questions that the clinical trials of the various statins attempt to answer are do statins work at reducing TC and LDL-C levels and if so by how much. In this project, it is clear that all of the statins in use at DDEAMC significantly reduce both TC and LDL-C ($p<.0001$ for all statins). In Table 13 a comparison of each statin's effect on the percent change in TC, the percent change in LDL-C, and the percent of patients reaching LDL-C goal is presented. Simvastatin patients

experienced the greatest decreases in percent change in TC and percent change in LDL-C resulting in 48% reaching LDL-C goal. It should be noted that 68% of the simvastatin patients were receiving an 80mg dose, the highest dosage form available. Of other particular interest is the atorvastatin patient. While these patients exhibited the second best percent change in LDL-C values, only 26.5% reached LDL-C goal. This phenomena is explained by the observation that 67.7% of the patients experienced less than a 30% reduction in LDL-C levels and 26% are less than eight LDL-C points from reaching their goal. Another observation that requires explanation centers on a comparison between cerivastatin and pravastatin. While both of these statins demonstrate nearly the same percent change in LDL-C (23.32 and 23.72) there is a 13% difference in the percentage of patients that reach their LDL-C goal. Several reasons that can explain this difference include:

1. Pravastatin patients were on statin therapy longer than the cerivastatin patients,

2. The pool of pravastatin patients is three times larger than the cerivastatin pool,

3. Only 9.52% of the cerivastatin patients experienced a 30-40% LDL-C reduction while 23.97% of the pravastatin patients had a LDL-C reduction of 30-40%.

Table 13

Statin Comparison of Effects on TC, LDL-C, and Goal Attainment

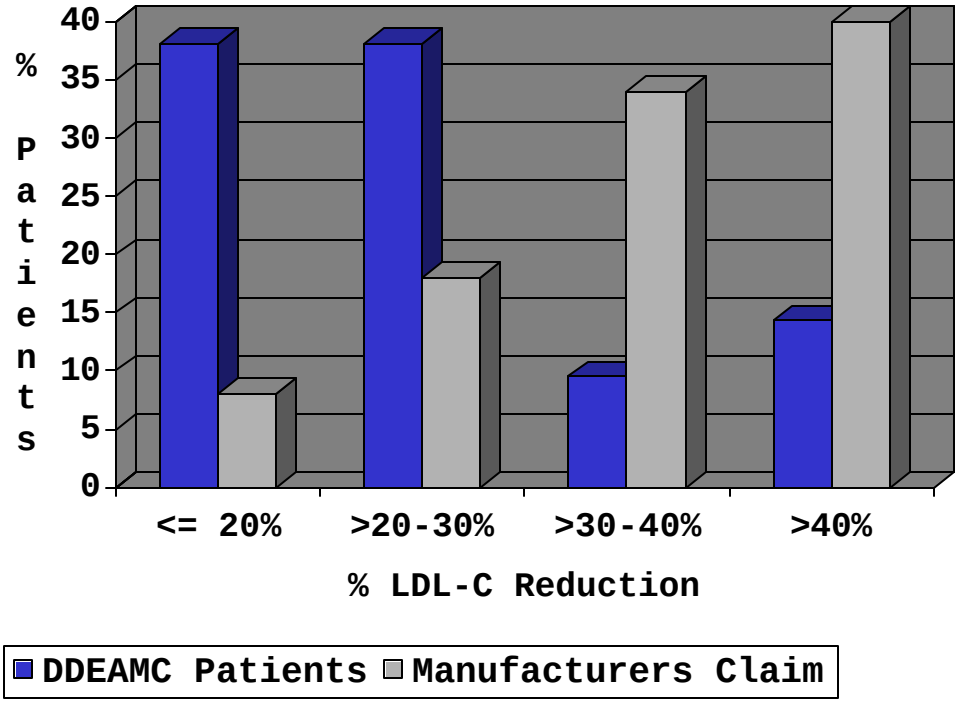
	% Change TC	% Change LDL-C	% Reaching LDL-C Goal
Atorvastatin	17.24	24.1	26.5
Cerivastatin	15.32	23.72	33.3
Pravastatin	17.84	23.32	46.3
Simvastatin	21.76	30.14	48
Mean	18.04	25.32	38.53
Standard Deviation	2.7	3.23	10.36

The average percent change in LDL-C for each of the statins at DDEAMC, 24.1% for atorvastatin, 23.72% for cerivastatin, 23.32% for pravastatin, and 25.32% for simvastatin, is markedly lower than the average range of 32-46% claimed by manufacturers (PDR, 1999). In Figure 1 a side by side comparison of percent LDL-C reductions is presented of the DDEAMC cerivastatin patients versus the manufacturers claim of LDL-C reductions. It is evident that the patients at DDEAMC are not achieving the results claimed by the manufacturer. In fact, the comparison clearly demonstrates a complete inverse of the manufacturers claim with 76% of the DDEAMC patients having 30% or less LDL-C reduction versus the 74% claim of 30% or greater LDL-C

reduction.

Figure 1

DDEAMC Cerivastatin Patients Vs Manufacturers Claim Comparison



In the final objective of this project the investigation of statin conversion on patient LDL-C was explored. The treatment modifications experienced by converted patients tends to suggest that comparable doses of all the statins studied have a similar effect when taken by patients who need to reduce their LDL-C level. This is consistent with the literature because in three previous studies in which lipid-lowering treatment was modified; no significant modification-related changes in serum lipid levels were observed (Korman & Borysiuk, 1995; Rindone, Arriola,

Hiller, & Achacoso, 1997). For DDEAMC patients, the slight decrease in LDL-C observed after conversion from pravastatin to simvastatin and pravastatin to cerivastatin may be partially explained by regression to the mean. This explanation is also applicable to the slight increase in LDL-C observed in patients converted from atorvastatin to simvastatin. Although the proportion of patients who met the NCEP's therapeutic objectives increased after the conversion switch, nearly 23% of them were still not meeting their LDL-C goal. These findings tend to add to the credibility of the DoD PEC directive limiting the statin class of drugs on the BCF.

CONCLUSIONS AND RECOMMENDATIONS

This project provides a value-added study for the DDEAMC Pharmacy Service by providing a comprehensive drug utilization review of statin therapy during FY 99 and research into the effects caused by statin conversions resulting from the DoD PEC mandate. The timeliness of this project is also advantageous to the Pharmacy Service because it provides excellent documentation of drug performance monitoring of a specific class of drug for the upcoming Joint Commission on Accreditation of Health Care Organizations (JCAHO) survey scheduled for May 2000.

While this project reached its desired outcome, various

issues and observations surfaced during the collection, analysis, and communication of data. Several of these points are detailed in the following paragraphs.

The CHCS database at DDEAMC contained all of the required pharmacy and laboratory data files needed to complete this project. The problem was determining a mechanism to filter out only those pharmacy records and laboratory test results pertinent to this study. The manipulation of this plethora of data would have been impossible without the aid of Microsoft Excel. With over 5,500 patients on statin therapy, the Excel program assisted in identifying the 358 patients starting statin therapy during FY 99 and the 345 patients that converted their medication during this study. It is highly recommended that anyone attempting this type of retrospective data recovery using CHCS as the data source have an exceptional working knowledge of the various sorting tools in Excel such as filters and pivot tables.

Once these patients were identified, the tedious process of individually looking up each patient’s lipid profile test results was accomplished. Several concerns surfaced during this data retrieval. First, there was no record of elevated TC or LDL-C levels on 9.8% of the patients that started statin therapy during FY 99. Second, for 21.2% of the patients that started

statin therapy there was not a follow-up TC or LDL-C test result twelve or more weeks after the dispensing of medication. The end result is that complete records were available for 247 patients or 69% of the original pool. Similar observations resulted from review of patients that underwent conversion of their statin therapy. Of the 345 statin conversion patients 287 or 83.2% had records acceptable for inclusion in this study.

The laboratory test result compliance rate was not consistent among the various clinics throughout DDEAMC. The Family Practice Clinic (FPC) and the Internal Medicine Clinic (IMC) had a greater than 90% compliance rate for laboratory tests while the rest of the clinic areas averaged 55% compliance. For statin conversion patients, the FPC and IMC had a greater than 95% compliance rate while the rest of the clinic areas achieved a 74% compliance rate.

The one major difference that separates the FPC and IMC from the rest of the clinic areas at DDEAMC is that they have a full time Doctor of Pharmacy (PharmD) assigned to the clinic. While this alone cannot account for this difference, it does suggest that having pharmacy oversight and council organic to clinic staffing appears beneficial. Further study using a cost-benefit analysis or other appropriate tool is recommended to quantify the quality and performance improvement associated with

having direct PharmD involvement in clinic operations.

In conclusion, this retrospective quantitative graduate management project accomplished all three of its objectives. First, it was determined that the most cost effective statin in LDL-C reduction used at DDEAMC during FY 99 was pravastatin. Second, it was determined that the newest statin, cerivastatin, is significantly more cost effective than any statin at LDL-C reduction used at DDEAMC during FY 99. Third, preliminary review of those patients undergoing conversion of their statin therapy experienced no significant change in the key indicators of their medication's performance.

Additionally, the projected cost savings of over $500,000.00 (40% reduction) at DDEAMC on statin drugs utilizing the contract pricing negotiated by the DoD PEC along with the results of this study indicate that this process was a sound management decision. For the health care administrator, this project supports the ideal that sound business practices that simultaneously consider clinical outcomes can successfully maximize the utilization of scarce health care resources.

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APPENDIX A

Acronyms

4S	Scandinavian Simvastatin Study Group
AHA	American Heart Association
BCF	Basic Core Formulary
CARE	Coronary and Recurrent Events
CER	Cost-Effectiveness Ratio
CHCS	Composite Health Care System
CHD	Coronary Heart Disease
DAPA	Defense Acquisition Procurement Authority
DDEAMC	Dwight D. Eisenhower Army Medical Center
DoD	Department of Defense
FPC	Family Practice Clinic
FY	Fiscal Year
HDL	High-density Lipoprotein
HDL-C	High-density Lipoprotein Cholesterol
HMG CoA	β-hydroxy-β-methylglutaryl-coenzyme A
HMO	Health Maintenance Organization
IMC	Internal Medicine Clinic
JCAHO	Joint Commission on Accreditation of Health Care Orgaizations
LDL	Low-density Lipoprotein
LDL-C	Low-density Lipoprotein Cholesterol

APPENDIX A (continued)

LTAP	Lipid Treatment Assessment Project
MHS	Military Health System
MTF	Military Treatment Facility
NCEP	National Cholesterol Education Program
PCABGTI	Post Coronary Artery Bypass Graft Trial Investigators
PharmD	Doctor of Pharmacy
PDR	Physicians’ Desk Reference
PEC	Pharmacoeconomic Center
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
TC	Total Cholesterol
TG	Triglycerides
VLDL	Very Low-density Lipoprotein
VLDL-C	Very Low-density Lipoprotein Cholesterol
WESCOPS	West of Scotland Coronary Prevention Study
YOLS	Year of Life Saved

APPENDIX B

FY 99 Statin Cost Matrix

Drug	Dose	Cost/Year	# Patients	Yearly Cost	Average per Patient
Atorvastatin	10MG	423	12	5076	
Atorvastatin	20MG	653	4	2612	
Atorvastatin	40MG	788	18	14184	
Atorvastatin	80MG	1576	0	0	
Total Atorvastatin			34	21872	**643.2941**
Cerivastatin	0.2MG	110	3	330	
Cerivastatin	0.3MG	110	4	440	
Cerivastatin	0.4MG	110	35	3850	
Total Cerivastatin			42	4620	**110.0000**
Pravastatin	10MG	244	10	2440	
Pravastatin	20MG	273	79	21567	
Pravastatin	40MG	474	32	15168	
Total Pravastatin			121	39175	**323.7603**
Simvastatin	5MG	376	0	0	
Simvastatin	10MG	376	1	376	
Simvastatin	20MG	628	2	1256	
Simvastatin	40MG	628	9	5652	
Simvastatin	80MG	628	38	23864	
Total Simvastatin			50	31148	**622.9600**
Simvastatin *	5MG	164	0	0	
Simvastatin *	10MG	241	1	241	
Simvastatin *	20MG	391	2	782	
Simvastatin *	40MG	391	9	3519	
Simvastatin *	80MG	391	38	14858	
Total Simvastatin *			50	19400	**388.0000**

***** Cost if new PEC contract pricing is used.

APPENDIX C

USE ATTACHED MICROSOFT EXCEL WORKSHEET FILE

APPENDIX C

Example Lab Result Matrix (Atorvastatin)

							RISK FACTORS 1 = Yes, 0 = Otherwise										
Reference #	AGE	SEX	DRUG Dose	BASE TC	BASE LDL	DRUG TC	DRUG LDL	AGE	HISTORY	DIABETES	HTN	SMOKE	GOAL REACHED	# FACTORS	TC Decrease	LDL Decrease	% LDL-C Reduction
H0470	58	0	40	263	160	260	152	1	0	1	1	0	0	3	3	8	5.00
U1737	56	0	40	272	158	258	152	1	0	1	1	0	0	3	3	8	5.06
K2863	58	0	40	266	162	260	153	1	0	1	1	0	0	3	6	9	5.56
H6589	69	0	40	266	161	262	145	1	0	1	1	0	0	3	4	16	9.94
F2671	55	1	10	345	232	321	208	1	0	1	1	0	0	3	24	24	10.34
L1696	59	1	10	375	240	319	210	1	0	1	1	0	0	3	56	30	12.50
P0958	52	1	10	296	233	290	210	1	0	1	1	0	0	3	56	30	12.88
B6787	70	1	10	367	243	323	211	1	0	1	1	0	0	3	44	32	13.17
A8061	71	0	10	300	176	255	148	1	0	1	1	0	0	3	45	28	15.91
M5614	68	1	40	300	198	261	166	1	0	1	1	0	0	3	39	32	16.16
D5217	54	0	10	289	167	256	138	0	0	1	1	0	0	2	33	29	17.37
H9487	44	0	10	316	180	252	146	0	0	1	1	0	0	2	64	34	18.89
F6103	51	0	10	304	178	252	146	0	0	1	1	0	0	2	64	34	19.10
H1772	77	1	40	299	204	258	163	1	0	1	1	0	0	3	41	41	20.10
L3335	61	1	20	284	176	236	137	1	0	0	0	1	0	2	48	39	22.16
B7256	58	1	20	320	186	225	138	1	0	0	0	1	0	2	95	48	25.81
C9736	67	1	20	313	188	227	138	1	0	0	0	1	0	2	86	50	26.60
P3658	61	1	20	302	180	233	132	1	0	0	0	1	0	2	95	48	26.67
W4054	56	0	40	276	193	212	138	1	0	1	0	0	0	2	64	55	28.50
J0160	58	0	40	272	194	216	138	1	0	1	0	0	0	2	56	56	28.87
L1394	61	1	40	325	235	261	167	1	0	1	1	0	0	3	64	68	28.94
T9061	64	0	40	265	190	214	138	1	0	1	0	0	0	2	64	55	28.95
H0486	74	0	40	277	193	214	136	1	0	1	0	0	0	2	63	57	29.53
J5229	56	0	40	257	164	231	114	1	1	0	0	0	1	2	26	50	30.49
G0478	65	1	40	322	236	264	164	1	0	1	1	0	0	3	58	72	30.51
P4589	62	0	40	280	193	212	133	1	0	1	0	0	0	2	68	60	31.09
B8886	56	0	10	280	164	222	112	1	1	0	0	0	1	2	58	52	31.71
O0075	65	0	40	256	162	220	107	1	1	0	0	0	1	2	36	55	33.95
G8058	79	0	40	253	163	222	100	1	1	0	0	0	1	2	31	63	38.65
E6199	77	0	10	274	170	199	102	1	1	0	0	0	1	2	75	68	40.00
T2031	65	0	40	250	162	220	97	1	1	0	0	0	1	2	30	65	40.12
R0077	57	0	40	283	156	223	108	1	1	0	0	0	1	2	30	65	41.67
H5791	57	0	10	284	169	194	96	1	1	0	0	0	1	2	90	73	43.20
P2338	65	0	10	288	169	198	99	1	1	0	0	0	1	2	90	73	43.20
Average	61.9412	0.3529	27.0588	291.7353	186.3235	243.2353	142.4118	0.9118	0.2647	0.6176	0.4706	0.1176	0.2647	2.3824	50.2647	44.9118	24.4868
STD Dev	7.9884	0.4851	14.2551	30.3528	26.8709	33.6326	32.3991	0.2879	0.4478	0.4933	0.5066	0.3270	0.4478	0.4933	26.1190	19.3287	11.3647

APPENDIX D

USE ATTACHED MICROSOFT EXCEL WORKSHEET FILE

APPENDIX D

Example Statin Conversion Lab Result Matrix

Reference #	AGE	SEX	Start Prava	TC	LDL-C	GOAL?	Change to Simva	TC	LDL-C	GOAL?	CHANGE	LDL Decrease
P1125	39	0	10	194	143	0	10	164	112	1	-1	31
B8646	73	1	10	168	107	1	10	110	60	1	0	47
R5873	76	0	10	190	105	1	10	184	94	1	0	11
P4832	72	0	10	223	109	1	10	244	126	1	0	-17
S1706	61	0	10	198	100	1	20	136	62	1	0	38
D5736	69	0	10	244	139	0	20	223	140	0	0	-1
T8203	63	1	10	233	122	1	80	166	86	1	0	36
A7487	75	0	10	215	118	1	80	213	114	1	0	4
H7499	54	0	20	217	137	0	20	133	93	1	-1	44
M3083	60	0	20	222	152	0	80	155	73	1	-1	79
P5608	61	0	20	310	168	0	80	248	83	1	-1	85
A2146	56	1	20	249	142	0	80	193	84	1	-1	58
S5966	60	1	20	221	134	0	80	152	89	1	-1	45
B0596	58	1	20	207	141	0	80	159	102	1	-1	39
S9627	75	0	20	248	144	0	80	179	108	1	-1	36
S5161	63	1	20	296	208	0	80	218	116	1	-1	92
M1779	67	0	20	284	163	0	80	240	122	1	-1	41
M6489	60	0	20	268	161	0	80	227	125	1	-1	36
S1524	64	1	20	217	141	0	80	229	130	1	-1	11
N8973	79	1	20	206	116	1	10	159	76	1	0	40
I1866	48	0	20	192	115	1	10	159	93	1	0	22
B2574	50	0	20	166	72	1	10	178	94	1	0	-22
C3715	64	0	20	221	109	1	10	216	109	1	0	0
L8300	67	0	20	200	100	1	10	234	127	1	0	-27
A8353	65	1	20	155	74	1	20	135	28	1	0	46
L6980	61	1	20	144	80	1	20	106	63	1	0	17
H6894	72	0	20	159	79	1	20	157	67	1	0	12
M7721	72	0	20	206	82	1	20	183	69	1	0	13
B3710	76	1	20	142	82	1	20	134	76	1	0	6
P1837	70	0	20	175	90	1	20	160	77	1	0	13
S7868	68	0	20	157	69	1	20	162	78	1	0	-9

APPENDIX D page 2

USE ATTACHED MICROSOFT EXCEL WORKSHEET FILE

APPENDIX D (continued)

Example Statin Conversion Lab Result Matrix (continued)

Reference #	AGE	SEX	Start Prava	TC	LDL-C	GOAL?	Change to Simva	TC	LDL-C	GOAL?	CHANGE	LDL Decrease
V7204	68	0	20	164	88	1	20	167	81	1	0	7
R1334	66	1	20	167	75	1	20	159	85	1	0	-10
B7788	69	1	20	160	102	1	20	148	85	1	0	17
M5529	70	0	20	164	83	1	20	196	86	1	0	-3
W0598	65	0	20	200	85	1	20	200	86	1	0	-1
C3966	73	1	20	171	110	1	20	162	88	1	0	22
W4519	83	0	20	221	120	1	20	210	88	1	0	32
W5747	64	1	20	176	113	1	20	154	94	1	0	19
G6785	69	1	20	174	74	1	20	191	97	1	0	-23
P0645	66	1	20	137	93	1	20	143	98	1	0	-5
C4899	70	0	20	200	108	1	20	200	100	1	0	8
W2132	75	0	20	189	108	1	20	193	101	1	0	7
B4321	74	1	20	153	103	1	20	166	102	1	0	1
B2000	70	1	20	165	103	1	20	161	102	1	0	1
S4623	82	1	20	180	94	1	20	176	105	1	0	-11
R8495	73	1	20	150	91	1	20	170	106	1	0	-15
I9630	69	0	20	184	104	1	20	192	113	1	0	-9
J9943	64	0	20	205	123	1	20	212	113	1	0	10
T2784	65	1	20	197	121	1	20	204	121	1	0	0
J8388	73	0	20	200	111	1	20	207	126	1	0	-15
R9467	74	0	20	203	130	1	20	204	130	1	0	0
B3602	69	1	20	260	138	0	20	312	192	0	0	-54
L7647	66	0	20	266	176	0	20	321	237	0	0	-61
M7995	88	1	20	178	113	1	80	96	38	1	0	75
W6009	60	1	20	171	58	1	80	185	57	1	0	1
J0003	59	1	20	168	60	1	80	144	60	1	0	0
P1933	71	1	20	150	63	1	80	171	63	1	0	0
B5157	66	0	20	153	86	1	80	145	68	1	0	18
H4151	73	1	20	140	94	1	80	114	68	1	0	26
C5721	76	1	20	183	113	1	80	140	70	1	0	43
C2428	64	0	20	214	96	1	80	167	76	1	0	20

APPENDIX D page 3

USE ATTACHED MICROSOFT EXCEL WORKSHEET FILE

APPENDIX D (continued)

Example Statin Conversion Lab Result Matrix (continued)

Reference #	AGE	SEX	Start Prava	TC	LDL-C	GOAL?	Change to Simva	TC	LDL-C	GOAL?	CHANGE	LDL Decrease
A4557	51	1	20	171	85	1	80	202	77	1	0	8
J2191	57	0	20	132	72	1	80	128	79	1	0	-7
W2274	60	0	20	148	90	1	80	163	79	1	0	11
N7962	66	1	20	174	117	1	80	143	79	1	0	38
M4694	48	1	20	199	88	1	80	149	80	1	0	8
W3501	68	1	20	198	115	1	80	146	83	1	0	32
K9470	61	1	20	188	117	1	80	157	85	1	0	32
C9041	73	0	20	210	106	1	80	133	87	1	0	19
R5976	76	0	20	192	101	1	80	186	88	1	0	13
C9778	66	1	20	158	113	1	80	149	89	1	0	24
H9799	62	0	20	179	119	1	80	154	98	1	0	21
W3194	74	0	20	165	105	1	80	184	114	1	0	-9
M1564	80	1	20	195	125	1	80	186	117	1	0	8
R5686	56	1	20	182	115	1	80	191	118	1	0	-3
C7712	69	1	20	193	99	1	80	207	128	1	0	-29
M1533	65	0	20	227	131	0	80	225	137	0	0	-6
G7922	68	1	20	209	140	0	80	218	138	0	0	2
H2126	68	0	20	234	146	0	80	236	148	0	0	-2
R9738	50	1	20	196	135	0	80	223	153	0	0	-18
S6490	45	1	20	264	166	0	80	246	165	0	0	1
D4080	62	0	20	223	116	1	20	258	155	0	1	-39
L0345	44	1	20	223	122	1	20	228	156	0	1	-34
L2232	53	1	20	216	130	1	20	233	165	0	1	-35
D0210	52	0	20	182	118	1	80	210	136	0	1	-18
R8345	66	1	20	208	114	1	80	230	137	0	1	-23
S2774	80	0	20	261	121	1	80	241	139	0	1	-18
S7642	68	1	20	199	115	1	80	234	142	0	1	-27
H3596	39	0	20	186	122	1	80	213	145	0	1	-23
M3133	68	1	20	195	110	1	80	227	156	0	1	-46
O3297	67	0	20	236	117	1	80	358	249	0	1	-132
A6476	66	1	40	240	143	0	80	215	100	1	-1	43

APPENDIX D page 4

USE ATTACHED MICROSOFT EXCEL WORKSHEET FILE

APPENDIX D (continued)

Example Statin Conversion Lab Result Matrix (continued)

Reference #	AGE	SEX	Start Prava	TC	LDL-C	GOAL?	Change to Simva	TC	LDL-C	GOAL?	CHANGE	LDL Decrease
L6550	67	0	40	344	134	0	80	270	102	1	-1	32
W4257	72	1	40	217	132	0	80	191	116	1	-1	16
W8610	67	0	40	224	146	0	80	199	122	1	-1	24
Z4643	69	0	40	185	98	1	10	193	98	1	0	0
S6744	56	0	40	190	94	1	20	163	78	1	0	16
G3007	63	0	40	172	79	1	20	185	83	1	0	-4
W5993	79	1	40	159	86	1	20	153	91	1	0	-5
C1259	68	1	40	154	100	1	20	151	99	1	0	1
H6107	79	0	40	227	106	1	20	237	115	1	0	-9
S5113	65	0	40	168	100	1	20	180	118	1	0	-18
S3102	65	0	40	151	96	1	20	179	122	1	0	-26
D9716	68	0	40	238	151	0	20	254	172	0	0	-21
P4106	72	1	40	224	126	1	40	193	122	1	0	4
H8572	64	0	40	121	58	1	80	147	58	1	0	0
J9586	73	1	40	186	92	1	80	129	66	1	0	26
S2330	58	1	40	136	75	1	80	131	70	1	0	5
L5835	73	1	40	175	109	1	80	138	76	1	0	33
S5380	81	0	40	176	101	1	80	146	81	1	0	20
F3650	66	1	40	196	119	1	80	154	83	1	0	36
R8866	80	1	40	184	117	1	80	175	86	1	0	31
M8625	80	1	40	166	96	1	80	162	94	1	0	2
D5158	74	1	40	185	99	1	80	175	95	1	0	4
R7709	77	1	40	150	92	1	80	162	96	1	0	-4
M7043	74	0	40	219	108	1	80	204	96	1	0	12
B4567	68	1	40	206	128	1	80	167	96	1	0	32
S5314	55	0	40	184	71	1	80	172	97	1	0	-26
V7204	68	1	40	143	82	1	80	159	99	1	0	-17
S5651	56	1	40	181	90	1	80	172	103	1	0	-13
M5350	56	0	40	182	84	1	80	199	105	1	0	-21
S3978	54	1	40	175	114	1	80	161	105	1	0	9
J9869	72	1	40	150	105	1	80	156	108	1	0	-3

APPENDIX D page 5

USE ATTACHED MICROSOFT EXCEL WORKSHEET FILE

APPENDIX D (continued)

Example Statin Conversion Lab Result Matrix (continued)

Reference #	AGE	SEX	Start Prava	TC	LDL-C	GOAL?	Change to Simva	TC	LDL-C	GOAL?	CHANGE	LDL Decrease
H3610	63	0	40	231	106	1	80	210	109	1	0	-3
B4271	62	1	40	189	110	1	80	209	113	1	0	-3
C4190	77	1	40	195	109	1	80	208	118	1	0	-9
D4588	63	0	40	209	96	1	80	221	119	1	0	-23
C4322	82	0	40	219	115	1	80	240	130	1	0	-15
Y3505	51	1	40	230	131	0	80	269	154	0	0	-23
H8030	58	1	40	207	147	0	80	226	166	0	0	-19
M5350	64	1	40	217	160	0	80	237	172	0	0	-12
D6567	58	0	40	212	118	1	80	226	133	0	1	-15
A3394	71	0	40	253	107	1	80	242	134	0	1	-27
P6582	67	0	40	231	118	1	80	277	195	0	1	-77
AVERAGE	66.1852	0.5111	25.7778	196.4000	110.7852	0.7926	54.9630	188.6000	106.1407	0.8148	-0.0222	4.6444
STD DEV	9.0175	0.5017	10.0348	37.1647	25.6772	0.4070	30.4659	43.4893	34.5137	0.3899	0.4647	29.7189